IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit 1761	:	
In re Application of	:	
G. A. VAN SCHOUWENBURG	:	METHOD FOR PREPARING A COHERENT PIECE OF MEAT
Serial No. 08/716,223	:	FROM SMALLER PIECES OF MEAT, AND THE COHERENT PIECE OF
Filed November 22, 1996	:	MEAT OBTAINED
Examiner - Curtis Sherrer	:	

DECLARATION

Assistant Commissioner for Patents
Washington, D.C. 20231

I, Dr. G. Wijngaards have a Master in Science and a Ph.D. from the University of Utrecht, am an author of about 100 scientific publications and have worked from 1973 onwards in the area of protein chemistry at the Netherlands Organisation for Applied Scientific Research TNO, in particular since 1983 in the area of protein and meat technology at TNO Nutrition and Food Research, declare as follows:

1. I am familiar with the subject matter of the above-identified application and of the teachings of U.S. Patent No. 4,772,477 to Weiss et al.

2. The Weiss patent discloses a method of producing meat products including (dry or fermented) sausage and emulsion-type sausage such as bologna.

a. Dry or fermented sausage (salami, cervelat) is typically produced by chopping lean meat and fat in a bowl chopper -generally at sub zero temperatures (-2 to -6 ^{0}C) - in such a way that a free flowing, granular mixture is formed with an evenly distributed, generally quite small particle size. Salt, flavoring, starter culture, and

other additives are added at this stage and mixed with the meat in the bowl chopper. From the bowl chopper the mixture is transferred into a stuffer and stuffed into casings after which the sausages are ripened and dried in special conditioned drying facilities.

b. This is also true for the process disclosed in the Weiss patent in which is given the example of genoa-salami. From beef (23,84%) and pork (70,79%) to which was added pepper, peppercorns, garlic, dextrose, salt, praque powder and 0.5% water, a pre-mix was made to be used for the subsequent experiments. In these experiments encapsulated citric acid was added to the pre-mix and thoroughly blended. After stuffing in a casing, the sausages were incubated and pH readings were taken during 48 hours.

c. An important feature in producing (dry) sausage such as described by Weiss in his example is a mixing step wherein meat pieces, seasoning, and the like are mixed together. The term "mixing" is well defined in the meat processing industry as meaning a process in which meat and ingredients are blended to evenly and homogenously distribute the components. This is generally done in the bowl chopper after the meat has been chopped to the desired size. The rotation of the knives is reduced (mixing position) and the ingredients are added (in a continuous flow) while the chopper turns. The action of the knives at this lower speed whirls and tosses the meat and the ingredients but no longer reduces the meat particles significantly in size. This mixing takes generally several minutes (measured in the number of turns of the bowl chopper). This mixing is a relatively gentle process as lean meat and the fat must, as this is one of the characteristics of these types of products, **not** fuse, but remain separate entities.

d. The production of bologna involves forming an emulsion with the meat protein. Lean meat and fatty raw materials are starkly reduced in size to the extent that individual lean and fat can no longer be distinguished. In this process meat proteins are set free and are used – generally with the help of water- to emulsify the fat. In the conventional processing a 2-phase process is used. First the lean meat is finely comminuted with water and salt to extract and set free the proteins.

In the second step, the fatty raw materials are added and comminuted, and free fat is emulsified. Very strong shear forces are required for this. Traditionally a bowl chopper is used for this. At maximum speed the meat is cut and cut again till a homogenous dough/slurry is formed.

3. The present invention requires a step of massaging and/or tumbling pieces of meat. This is a well-known process in the meat industry and is used to add and/or evenly distribute water and salt in pieces of meat, and/or to soften meat, and/or to make it more pliable, and/or to extract meat proteins. An example of a device for massaging or tumbling meat is disclosed in U.S. Patent No. 4,517,888 (reproduced in Appendix A hereto) but many other apparatus are in use to achieve the massaging and/or tumbling effects; the meanings of the terms "massaging" and "tumbling" in the food processing industry are set forth therein at column 1, lines 24-32 and 47-54. In massaging and/or tumbling, water and salt are added, either by injecting the meat with brine or directly and meat is tumbled or scooped and thoroughly tossed about. The salt and water are absorbed and evenly distributed throughout the meat muscles/pieces of meat. Proteins solubilized by salt are extracted and transported to the outside of the meat pieces. Meat that has been tumbled or messaged is characterized by the fact that it is covered with a clearly visible mass of creamy, paste-like, and very tacky exudate.

4. The mixing in dry sausage or emulsion sausage production such as mentioned by Weiss and massaging and/or tumbling meat pieces to produce a coherent piece of raw meat as in the present invention are being distinct for the following reasons:

- In dry sausage production, the aim of mixing is to distribute the ingredients evenly. The meat is not 'worked'; on the contrary, it is a very gentle process whereby pieces of meat and fatty tissue remain separate, and the mixture is virtually free flowing favored by the low temperature.
- To make an emulsion, the meat and fatty raw materials must be homogenized and pieces of meat are no longer visible to the naked eye. An emulsion can in no way be considered as a coherent piece of meat.

- Massaging and tumbling are used to distribute water and salt evenly through pieces of meat/meat muscle while keeping the meat structure intact. During tumbling, protein is extracted. This solubilized protein has particular binding properties and is used to bind either through cohesion (chicken steaks), heating (boiled ham) or -as is subject of the present application- by locally denaturing it.
- No expert or person familiar with meat processing would use tumbled meat to make a bologna or salami. These are distinct processes with distinct applications.

5. The above-identified application claims a step of massaging and/or tumbling meat pieces with a salt to solubilize proteins on the surfaces of the meat followed by delayed acidification of the solubilized proteins.

- One seeking to produce fermented genoa-type salami sausage would not perform such steps because it would not result in a product that could be preserved raw and would not have the distinct marbling of a salami.
- One seeking to produce an emulsion-type sausage would not use tumbled meat as the appearance and consistency of a product made from tumbled meat which is subsequently cooked would not resemble a bologna or frankfurter type sausage. The tumbling process is specifically applied for great(er) pieces of meat. Consequently, in case of the production of an emulsion-type sausage tumbling would mean that additional chopping is necessary to obtain the structure and appearance of a comminuted meat product. Tumbling would add no benefits of any kind and is superfluous. Furthermore, any fat, if not being emulsified, would melt and separate.
- Adding encapsulated (citric) acid to either the mix described in the examples 1-3 in the Weiss patent or to a bologna type sausage emulsion, would not result in localized denaturation of solubilized proteins and would not bind pieces of meat together in the way as described in the present invention. The use of meat acidulants as described in the Weiss patent aims to reach a quite different effect than that in the present invention. In the meat products mentioned by Weiss, the effect is directed to improvement of consistency, and additionally of taste and

shelf-life, whereas the effect of the present invention is binding of meat particles. The latter requires different processing conditions and is targeted locally (between the meat particles). In the applications mentioned by Weiss acidification targets the whole product. Therefore, the process of the present invention cannot be deduced from the Weiss patent. Gelling that occurs in meat emulsions at a pH below the iso-electric point (Weiss column 1, lines 11-18) is well understood. In non-emulsion products, such as Weiss's genoa-type salami, some gelling is also expected to take place, but the product really sets during the ripening and drying phase. In the present invention a different process must take place as can be demonstrated in the following way. The "bacon reepjes" (bacon Julienne) produced with the acid coagulation process and available in the Ahold supermarkets of The Netherlands show this clearly. When pulling on each end, considerable force is required to break the 6-7 cm long 1 cm square product. The force is equal to the force that is required to tear a traditionally produced bacon of similar dimensions. The torn ends more often than not are torn muscle, i.e. the acid coagulation bindings are at least as strong as the meat muscle itself. A salami, on the other hand, is after 24 hours (the pH drops well below 5.0 in the first day, but moisture loss is generally less than 5%), still spreadable with a knife, which the bacon julienne is clearly not. The acidification in Weiss's process must, therefore, have a different effect than in the acid coagulation process. In the present application, an explanation is given for this. It is very clear that the Weiss process and the process in the application are quite different.

6. The production of sausages and the claimed invention of producing a coherent piece of raw meat from smaller pieces of meat are so dissimilar in their underlying steps and ultimate desired product that one seeking to produce a coherent piece of raw meat would not look for suggestions in doing so from a reference concerning sausage production such as the Weiss patent.

7. I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

G. Wijngaards

18 July 2000

Date

United States Patent [19]

Weiss et al.

[11] **Patent Number: 4,772,477**

[45] **Date of Patent: Sep. 20, 1988**

[54] **MEAT ACIDULANT**

[75] Inventors: **Herbert D. Weiss, Suffern, N.Y.; Robert G. Reynolds, Harrington Park, N.J.**

[73] Assignee: **Balchem Corporation, Slate Hill, N.Y.**

[21] Appl. No.: **920,185**

[22] Filed: **Oct. 17, 1986**

[51] **Int. Cl.**[4] **A23L 1/221; A23L 1/317**

[52] **U.S. Cl.** **426/99; 426/646; 426/650; 426/652**

[58] **Field of Search**..... 426/99, 646, 650, 652, 92

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,648,609	8/1953	Wurster .	
2,799,241	7/1957	Wurster .	
3,015,128	1/1962	Somerville, Jr. .	
3,110,626	11/1963	Larson et al. .	
3,159,874	12/1964	Langer et al. .	
3,247,065	4/1966	Koff .	
3,279,994	10/1966	Koff .	
3,293,132	12/1986	Stoyle et al. .	
3,341,466	9/1967	Brynko et al. .	
3,682,887	8/1972	Yoshioka et al. .	
3,819,838	6/1974	Smith et al. .	
4,068,006	1/1978	Moritz	426/650 X
4,497,845	2/1985	Percel et al.	426/646
4,511,584	4/1985	Percel et al.	426/99
4,511,592	4/1985	Percel et al.	426/646
4,537,784	8/1985	Percel et al.	426/303

OTHER PUBLICATIONS

Avicel Application Bulletin, No. PH-11, Durkee Industrial Foods, p. 5.

Eastmann Products Publication No. ZM-80F, Eastman Kodak, pp. 6-7.

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[57] **ABSTRACT**

The present invention provides an acidulant and a method of acidulating moist meat and meat emulsions at meat processing temperatures in the range of about 32° F. to 135° F. The method comprises mixing a coated acidulant into the meat or meat emulsion, the acidulant having a coating effectively encapsulating the acidulant. The coating comprises a mixture of about 50-70 wt. % of a water-soluble glyceride and about 30-50 wt. % of a hydrogenated vegetable oil.

14 Claims, No Drawings

MEAT ACIDULANT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the acidulation of meat and other food products and particularly to a method of acidulating, and a coated acidulant, effective in low temperature food processing.

2. Description of the Prior Art

The acidulation of meat products, particularly meat emulsions, is well known. Meat emulsions, for instance sausage emulsions, are mixtures of lean meat or meat protein and water forming a matrix in which fat particles, salt, sugar and curing agents are dispersed. It is also well known that meat emulsions will set up and harden as the pH of the emulsion decreases. Therefore, in order to assure easy processability, it is necessary to avoid lowering the pH of the emulsion during the early stages of preparation and processing. For instance, meat emulsions begin to harden at pHs below about 5.2 and especially at pHs below about 5.0, making it impossible to stuff the meat into casings for the production of sausages and like products. Generally, the emulsions remain processable at pHs above about 5.2. However, it is desirable to lower the pH of the final product below this level in order to enhance flavor and appearance (i.e. color), achieve a more solid texture and lengthen storage life.

Acidulation of food in the past has been accomplished by various means. One method comprises inoculating the food mass with a small amount of previously fermented food. The resulting inoculated food mass was then allowed to ferment for an extended period of time. Fermentation using this method was very slow due to the time required for bacteria to grow and produce acids (usually lactic acid) which eventually lowered the food pH to the desired level.

Another method of acidulating food comprises adding acid directly to the food. In meat emulsions and like products, especially ground meat products, localized high concentrations of acid (so-called "hot spots") must be avoided since they can degrade the appearance and taste of the finished food product. In order to avoid this problem, the acid must be quickly dispersed throughout the food mass. This requires special mixing apparatus able to operate under extremely stringent parameters. Even in cases where the added acid could be quickly and effectively dispersed, there remained the problem of substantially instantaneous set-up (hardening) of the food, before the final food processing steps could be completed.

One solution to the fast set-up problem was to add glucono delta lactone, rather than an acid, directly to the food. Glucono delta lactone reacts with water present in the food and hydrolyzes into gluconic acid. In practice, it was discovered that the acid-producing glucono delta lactone had a tendency to prematurely hydrolyze, and accordingly, had to be quickly dispersed throughout the emulsion. Due to the difficulty in controlling the rate and extent of hydrolysis, glucono delta lactone has only received limited acceptance as a food acidulant.

Another approach has been to coat solid granular acids with either a wax, a monoglyceride or a vegetable oil. When meats containing these coated granular acids are subjected to higher temperatures, such as in a smokehouse, the coatings melt thereby releasing the acid. For example, U.S. Pat. Nos. 4,537,784 and 4,511,584 both disclose lipid coatings for micro-encapsulated solid granular acids useful in food processing at temperatures in the range of 100°–150° F. The coatings are primarily triglycerides, but may also contain mono- and diglycerides. These patents further disclose that when the temperature of the food containing the coated acidulant is raised above the melting point of the triglyceride coating, the coating melts thereby releasing the acid. One problem with this procedure is that not all foods are processed at temperatures above 100° F. For instance, summer sausage, Genoa salami, and some German sausages are subject to maximum (i.e, smokehouse) temperatures of only 75°–80° F., which is below the melting point temperature of these types of acidulant coatings. Although acidulant coatings having a melting point in the range of about 75°–80° F. are known, acidulants having these coatings must be refrigerated until immediately before use, otherwise there is the danger of premature melting during shipment and handling.

U.S. Pat. No. 4,511,592 discloses an acidulant coating which does not depend upon melting the coating in order to release the acidulant. The coating material disclosed in this patent comprises an edible hydrolized starch and a protein. Once this coating comes in contact with water contained in the meat emulsion, the coating quickly dissolves thereby releasing the acid. In practice, it was discovered that the coatings disclosed in U.S. Pat. No. 4,511,592 are so water soluble that very little acid release delay is provided. For instance, in cases where the coating is extremely thick, (i.e., in cases where the coating comprises about 50 wt. % of the coated acidulant) the coating typically dissolves and releases the acid in a matter of minutes. In industrial processes, this is insufficient time in order to complete the processing of the meat emulsion, i.e. to stuff it into casings in the case of sausage production.

Thus, there has been a need in the art for an acidulant and a method of acidulating meat emulsions and other food materials which are subject to lower processing and smoking temperatures and yet which still provides adequate time delays, on the order of at least one and preferable at least two hours, before enough of the acidulant is released to lower the pH to a level where the food material sets up.

SUMMARY OF THE INVENTION

The present invention provides both a coated acidulant and a method of delayedly acidulating moist food and food emulsions at food processing temperatures in the range of about 32° F. to 135° F. The method comprises mixing a coated acidulant into the food or food emulsion, the acidulant having a coated effectively encapsulating the acidulant. The coating comprises a mixture of about 50–70 wt. % of a water-soluble glyceride and about 30–50 wt. % percent of a hydrogenated vegetable oil. Once the coated acidulant has been completely mixed into the food emulsion, water-contained in the food, after a suitable delay period, dissolves the water soluble glyceride component of the coating thereby destroying the coating and releasing the acidulant into the food. Coatings of this type typically provide a minimum delay period, between the time of first introducing the coated acidulant into the food and the time when a substantial pH drop in the food occurs, on the order of at least one hour. In preferred embodiments of the pres-

ent invention, the delay period is at least about two hours.

DETAILED DESCRIPTION OF THE INVENTION

The present invention can be practiced with a number of food products in which acidulants are added in either a preservation or texturizing amount. The present invention has particular usefulness in the processing of certain meat products which are processed at temperatures below about 135° F. and particularly below about 100° F. Because of the absence of high temperatures during meat processing and smoking, conventional fat encapsulated acidulants cannot be employed since the fat coating does not melt at such low processing temperatures. The present invention provides advantages over acidulants having low temperature (i.e., 75°–80° F.) melting points, since the acidulants of the present invention don't need to be refrigerated before use. In the present invention, a portion of the coatings are water soluble and hence the moisture contained in the meat destroys the coating thereby causing acid release.

One example of a meat product which may be acidulated according to the present invention is winter sausage. Another example is a fermented sausage commonly known as summer sausage. Other types of fermented sausages which may be acidulated according to the methods of the present invention include Lebanon bologna, pepperoni, pork roll and cervelats (Farmer, Holsteiner, and Thuringer). Other emulsion-type sausages with which the present invention is useful include frankfurters, bologna, and dry sausages such as salami. Other meat products such as chopped meatloaf and potted comminuted meats can also be acidulated in accordance with the present invention.

Food grade acids useful in practicing the present invention include water soluble acids and other agents suitable for lowering the pH of moist food products, normally in solid or crystalline form. Examples include citric acid, ascorbic acid, tartaric acid, fumaric acid, adipic acid and glucono delta lactone which hydrolyzes into gluconic acid. In addition, food grade liquid acids applied to a suitable solid granular carrier may also be used. One example of such a liquid acid and carrier includes lactic acid on either calcium lactate, as described in U.S. Pat. No. 4,537,784, or on microcrystalline cellulose gels such as those sold by FMC Corporation, Philadelphia, PA., under the trademark AVICELL TM PH-101.

The term "acidulant" as used herein denotes both solid food grade acids as well as liquid food grade acids applied to a solid granular carrier. The term also encompasses compounds which react with water in the food to form acids, such as glucono delta lactone.

The acidulant coatings employed in the present invention comprise mixtures of about 50–70 wt. % of one or more water soluble glycerides and about 30–50 wt. % of one or more hydrogenated vegetable oils. Preferably, the mixture comprises about 60 wt. % percent of one or more water soluble glycerides and about 40 wt. % of one or more hydrogenated vegetable oils.

Useful water soluble glycerides include oxidatively stable mono- and diglycerides having film-forming properties and oxygen and moisture barrier properties. Preferably these glycerides are of edible quality for culinery purposes. Examples of suitable water soluble edible glycerides include distilled acetylated monoglycerides sold by Eastman Chemical Products, Inc., Kingsport, TN, under the trademark MYVACET TM; and mono- and diglyceride mixtures sold by Durkee Industrial Foods division of SCM Corporation, New York, NY, under the trade names DUR-EM TM and DURO-LO TM. In addition, mixtures of distilled monoglycerides and hydrogenated vegetable oils sold by Eastman Chemical Products, Inc., under the trademark MYVATEX TM may also be used as long as the glyceride/hydrogenated vegetable oil contents are within the above-mentioned ranges. A particularly preferred water soluble glyceride in the DUR-EM TM 207E product, a mixture of mono- and diglycerides containing at least 50% monoglycerides having a maximum iodine value (IV) of 5 (centigrams/gram of fat) and a capillary melting point in the range of 140°–146° F.

Suitable hydrogenated vegetable oils include triglycerides such as hydrogenated cottonseed, corn, peanut, soybean, palm, palm kernel, babassu, sunflower and safflower oils. Preferred hydrogenated vegetable oils include hydrogenated palm oil, cottonseed oil and soybean oil sold by Durkee Industrial Foods division of SCM Corporation under the trademarks DURKEE TM 07, 17, 27; DURATEX TM, KAORICH TM, KLX TM and ARATEX TM. A particularly preferred hydrogenated vegetable oil is the DURKEE TM 27 product, a hydrogenated palm oil, marketed in bead form and having a melting point in the range of about 136°–144° F.

The method of applying the coating to the acidulant is not critical, forms no part of the present invention and may be performed in any number of known manners. For instance, the acidulant particles may be suspended in the liquid coating and the suspension sprayed into a "freezing chamber". Alternatively, the particles may be sprayed with the coatings of the present invention, the particles being suspended by a flow of air (fluidized bed). U.S. Pat. Nos. 4,511,584 at columns 3–5 and 4,511,592 at column 4, the disclosures of which are incorporated herein by reference, teach preferred methods of applying fat coatings to granular acidulants. U.S. Pat. Nos. 4,537,784 at columns 3–4; 4,497,845 at column 4; 3,819,838; 3,341,466; 3,279,994; 3,159,874; 3,110,626; 3,015,128; 2,799,241; and 2,648,609, whose disclosures are all incorporated herein by reference, teach additional methods and apparatus for applying coatings which may be used to produce the coated acidulants used in the present invention.

In order to provide adequate time delays between the time when the coated acidulant is first introduced into the moist food product and the time when substantial acid leach begins to occur, it is important that the coatings effectively cover the acidulant surface. By the term "delayed release coating" it is meant that the coating is sufficiently thick and sufficiently continuous to ensure that the pH of the moist food product does not drop below about 5.0 within the first hour, and preferably within the first two hours. Typically, the coated acidulant will have a particle size distribution substantially within the range of 10–80 screen mesh. For these size particles, the coating typically comprises from about 20 to about 50 weight percent of the coated acidulant.

Although certain embodiments of the invention have been selected for description in the Examples hereinafter, it will be appreciated by those skilled in the art that these examples are merely illustrative of, but do not in any way limit the scope of the present invention which is defined in the appended claims.

EXAMPLES 1 AND 2

A thirty-pound batch of sausage was prepared using a genoa-type salami formula. The sausage was divided into two, fifteen-pound batches for subsequent addition of encapsulated citric acid at 0.666 wt. % and 1.0 wt. % levels. The citric acid coating was comprised of 40 wt. % hydrogenated palm oil and 60 wt. % DUR-EM TM 207E. The compositions of the two batches were as follows (all percentages are percent by weight):

Composition	Example 1	Example 2
Ground pork	70.97%	70.73%
Ground beef	23.84%	23.76%
White pepper	0.179%	0.178%
Peppercorns	0.060%	0.059%
Garlic powder	0.015%	0.015%
Dextrose	0.953%	0.950%
Salt	2.574%	2.566%
Prague Powder	0.238%	0.238%
Water	0.5%	0.5%
Encapsulated citric acid	0.666%	1.0%

The first nine ingredients were combined and mixed thoroughly. The thirty-pound blend of ingredients was divided into two fifteen-pound batches, and the two different citric acid levels were added, followed by thorough mixing. The sausage blend was then stuffed into #3½ cellulose casings, tied and incubated at 80° F. for 24 hours. At timed intervals over the incubation period, samples were prepared for pH readings, which are presented in Table 1.

EXAMPLE 3

A seven-pound batch of sausage was prepared using a genoa-type salami formula with encapsulated citric acid. The citric acid coating was comprised of 40 wt. % hydrogenated palm oil and 60 wt. % DUR-EM TM 207E. The composition of the batch was as follows:

Composition	wt. %
Ground pork	70.97
Ground beef	23.84
White pepper	0.179
Peppercorns	0.060
Garlic powder	0.015
Dextrose	0.953
Salt	2.574
Prague Powder	0.238
Water	0.5
Encapsulated citric acid	0.666

The first nine ingredients were combined and mixed thoroughly. The encapsulated citric acid was added to the mixture and blended. The sausage blend was stuffed into #3½ cellulose casings, tied and incubated at 32° F. At timed intervals during incubation, samples were prepared for pH readings, which are presented in Table 1.

TABLE 1

Genoa Salami, Examples 1–3; pH Values at Timed Intervals During Incubation.

	Incubation temperature and (wt. % Encapsulated Citric Acid)		
Incubation Time (Hrs)	32° F. (0.666%) Example 3	80° F. (0.666%) Example 1	80° F. (1.0%) Example 2
(Before addition of citric acid)	5.85	—	—
0	5.79	5.70	5.48
2	5.04	5.24	5.00
4	—	5.04	4.77
5	4.70	—	—
6	4.70	—	—
16	—	4.66	4.38
18	—	4.55	4.33
22	4.74	4.59	4.54
24	4.80	4.60	4.40
48	4.66	—	—
48 (after heating)	4.63	—	—

Although the present invention has been described in terms of a number of specific examples and embodiments thereof, it will be appreciated by those skilled in the art that a wide variety of equivalents may be substituted for the specific compounds and steps of operation described herein, all without departing from the spirit and scope of the present invention, as defined in the appended claims.

We claim:

1. An acidulant for lowering the pH of a moist comminuted meat product, the meat product having an initial pH of about 6 and which is to be processed at a maximum processing temperature below about 135° F. to a pH level below about 5.2 in not less than one hour after adding the acidulant to the meat product, the acidulant having a delayed release coating encapsulating the acidulant, about 50 to 70 wt. % of the coating consisting of at least one water soluble glyceride, said water soluble glyceride having a melting point above said maximum processing temperature, and about 30 to 50 wt. % of the coating consisting of at least one hydrogenated vegetable oil, said hydrogenated vegetable oil having a melting point above said maximum processing temperature.

2. The acidulant of claim 1, wherein the water soluble glyceride is selected from the group consisting of oxidatively stable, film-forming, oxygen and moisture impervious, water soluble monoglycerides, diglycerides and mixtures thereof.

3. The acidulant of claim 1, wherein the hydrogenated vegetable oil is selected from the group consisting of hydrogenated palm oil, hydrogenated cottonseed oil, hydrogenated soybean oil, hydrogenated corn oil, hydrogenated peanut oil, hydrogenated palm kernel oil, hydrogenated babassu oil, hydrogenated sunflower oil, hydrogenated safflower oil and mixtures thereof.

4. The acidulant of claim 1, wherein the hydrogenated vegetable oil comprises hydrogenated palm oil.

5. The acidulant of claim 1, wherein the coating comprises about 60 wt. % of the water soluble glyceride and about 40 wt. % of the hydrogenated vegetable oil.

6. The acidulant of claim 5, wherein the hydrogenated vegetable oil comprises hydrogenated palm oil.

7. The acidulant of claim 5, wherein the water soluble glyceride comprises a mixture of mono- and diglycerides containing at least 50% monoglycerides, having a

maximum IV value of 5 and a capillary melting point in the range of 140°–146° F.

8. The acidulant of claim 1, wherein the acidulant comprises a liquid acid and an acid carrier.

9. The acidulant of claim 8, wherein the acid comprises lactic acid and the carrier is selected from the group consisting of calcium lactate and microcrystalline cellulose.

10. The acidulant of claim 1, wherein the acidulant comprises a material selected from the group consisting of citric acid, ascorbic acid, tartaric acid, fumaric acid, adipic acid, lactic acid and glucono delta lactone.

11. A moist comminuted meat product containing the acidulant of claim 1.

12. The moist comminuted meat product of claim 11, wherein the meat product is selected from the group consisting of winter sausage, summer sausage, pepperoni, Lebanon bologna, pork roll, cervelats, frankfurters, bologna, salami, chopped meatloaf and potted comminuted meats.

13. A coated acidulant for acidulating a moist comminuted meat product, the acidulant having a delayed release coating containing 30 to 50 wt.% of that least one hydrogenated vegetable oil and 50 to 70 wt. % of at least one water soluble glyceride, which is soluble by water contained in the meat product, the water soluble glyceride being effective to delay releasing the acidulant into the meat product for a period of at least one hour after the acidulant is added to the meat product while the meat product is maintained at a temperature within the range of about 32° to below 135° F.

14. The moist comminuted meat product containing the acidulant of claim 13.

* * * * *

United States Patent [19]

Gould

[11] Patent Number: 4,517,888

[45] Date of Patent: May 21, 1985

[54] **FOOD PROCESSOR**

[75] Inventor: Bruce M. Gould, Fullerton, Calif.

[73] Assignee: Challenge-Cook Brothers, Inc., City of Industry, Calif.

[21] Appl. No.: 605,990

[22] Filed: May 2, 1984

Related U.S. Application Data

[63] Continuation of Ser. No. 196,876, Oct. 14, 1980, abandoned.

[51] Int. Cl.³ A23B 4/02; B01F 13/06

[52] U.S. Cl. 99/472; 69/30; 99/535; 366/139; 366/227; 366/233

[58] Field of Search 99/472, 516, 534-536; 366/57-59, 135, 139, 163, 191, 225, 227, 228, 233; 220/244, 260, 314; 34/92; 69/30

[56] References Cited

U.S. PATENT DOCUMENTS

2,598,915	6/1952	Huzenlaub et al.	99/472
3,161,403	12/1964	Lincoln et al.	
3,175,811	3/1965	Jackson	
3,518,849	7/1970	Eggleston	
3,665,735	5/1972	Brennan	
3,746,316	7/1973	Langen et al.	
3,803,882	4/1974	Brennan	
3,880,067	4/1975	Hoffman	
3,934,860	1/1976	Michels et al.	
4,029,824	6/1977	Langen	
4,036,122	7/1977	Langen	
4,038,426	7/1977	Jespersen et al.	
4,120,981	10/1978	Burkhart	
4,173,925	11/1979	Leon	
4,188,869	2/1980	Komen	99/584
4,191,527	3/1980	Trouillard	
4,214,518	7/1980	Petsche	99/535

FOREIGN PATENT DOCUMENTS

1066267	11/1979	Canada	366/59
2460113	2/1981	France	99/535
175478	10/1978	Fed. Rep. of Germany	
2720732	10/1978	Fed. Rep. of Germany	
2814881	2/1979	Fed. Rep. of Germany	
311210	3/1979	Fed. Rep. of Germany	
405305	5/1972	United Kingdom	
1478830	7/1977	United Kingdom	

OTHER PUBLICATIONS

Ribbon Blenders-Functional Design By Munson.

Langden-Translation of a 30-Years' Experience In The Newest Technology For Ham-And Shoulder Processing.

Challenge Cook-Hide Processor Specification-Sheet HC-212.

Challenge Cook-Hide Processor Specification Sheet HP-150.

Telephone Message Taken By Applicant, Mar. 1975 Re Nor-Western Products, Inc.

John Aulson, Handwritten Notes Following Visit To Nor-Western.

Meat Industry-The Massaging-Tumbling Revolution-Apr. 1977.

Meat Industry-Why Massage Or Tumble-Nov. 1977.

Meat Industry-Ham Tumbling-Jun. 1978.

Challenge-Cook Bros., Inc.-News Release-May 25, 1978.

Oscar Mayer & Co.-Request For Quotation-Jul. 7, 1978.

Nabisco, Inc.-Letter To Challenge-Cook, Inc.-Mar. 26, 1979.

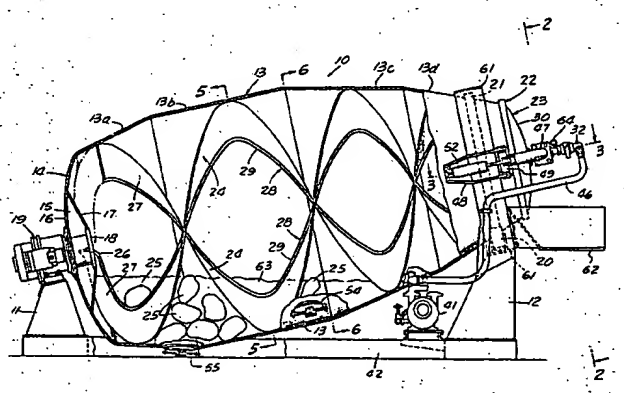
Primary Examiner—Timothy F. Simone

Attorney, Agent, or Firm—Lyon & Lyon

[57] ABSTRACT

Apparatus for kneading food pieces includes a rotatable drum mounted on an inclined axis. There are spiral flights along the side wall of the drum. Charging and discharging the drum is effected through an open end and the drum includes a door for airtight sealing of the drum. A vacuum can be drawn inside the drum for different types of food processing. The processor can be used for blending constituents for food products. The kneading action can be applied to massaging or tumbling meat chunks, and treatment liquids can be added to the drum and/or the food pieces for processing.

51 Claims, 8 Drawing Figures



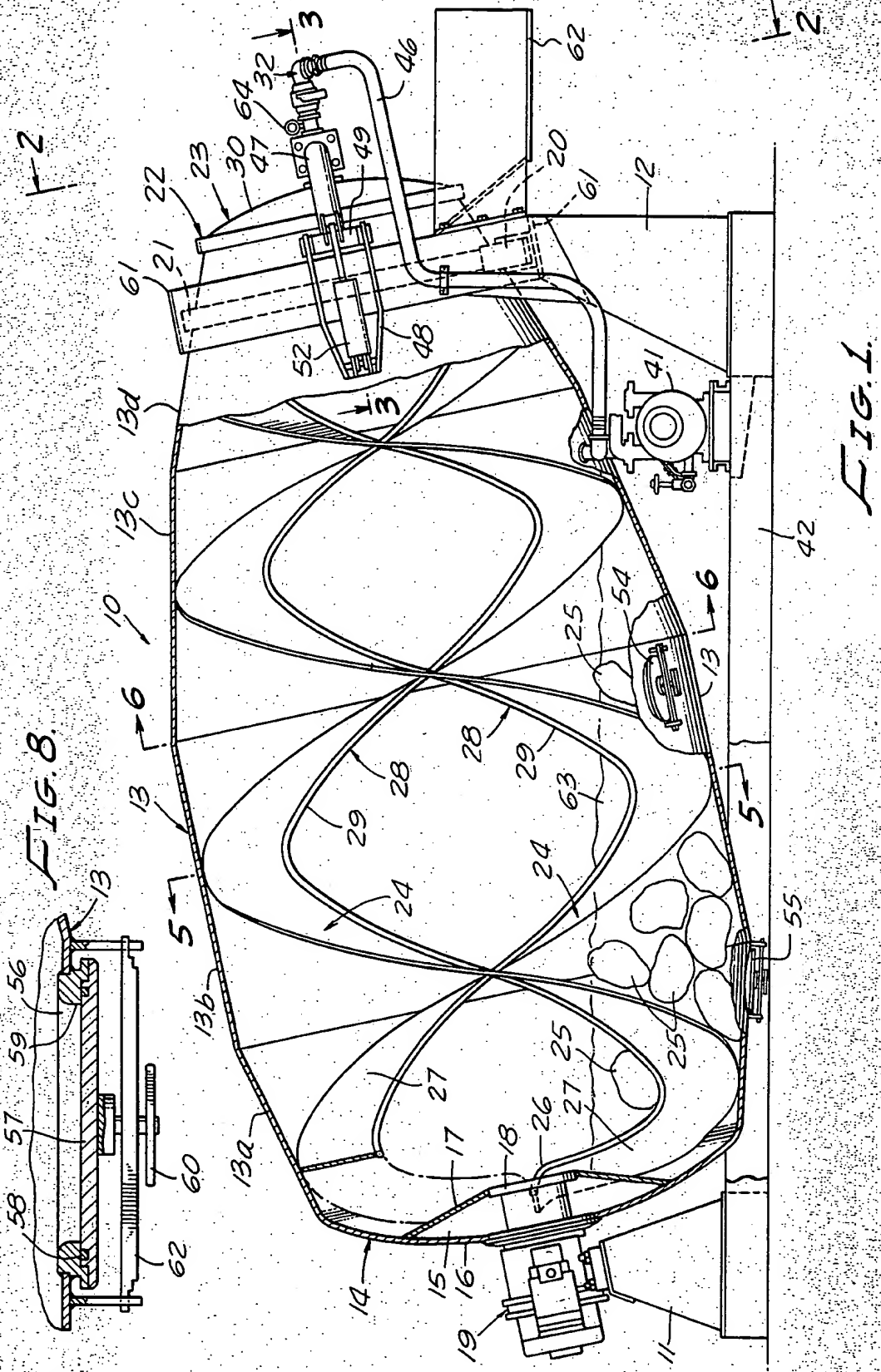

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FIG. 1.

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FIG. 8.

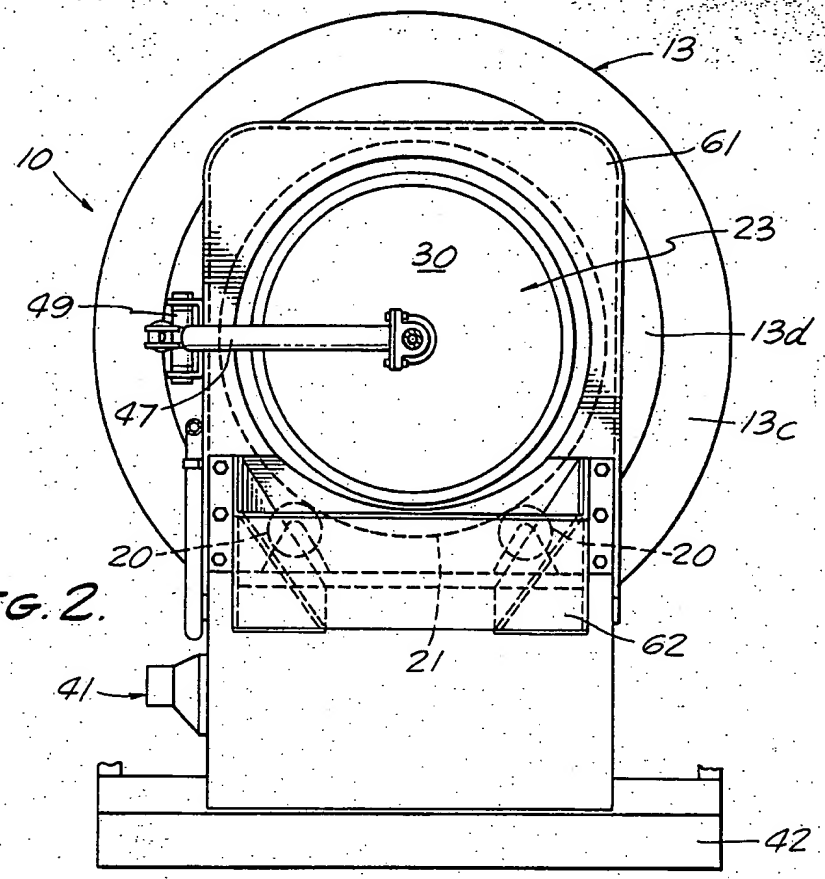


FIG. 2.

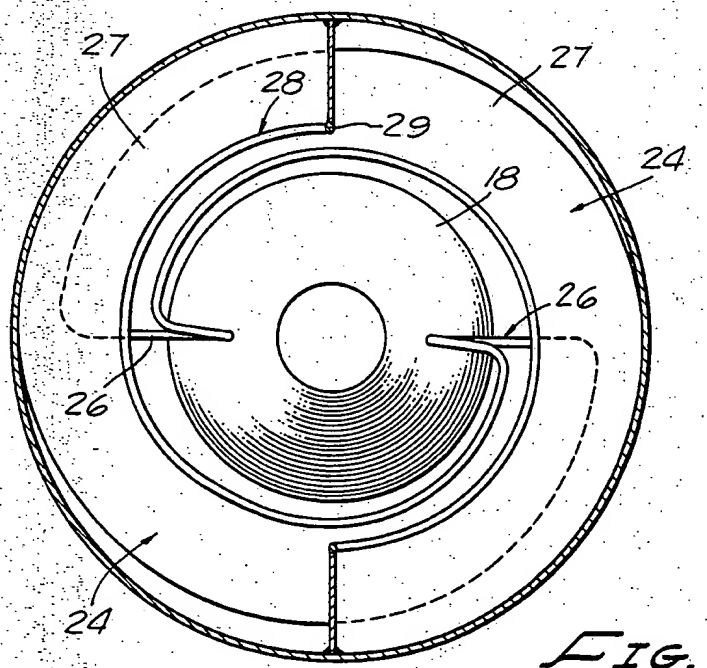
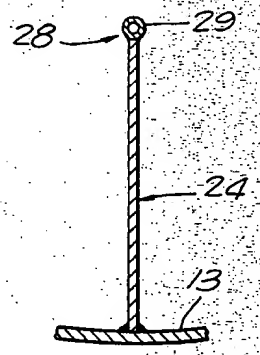


FIG. 6.

FIG. 7.



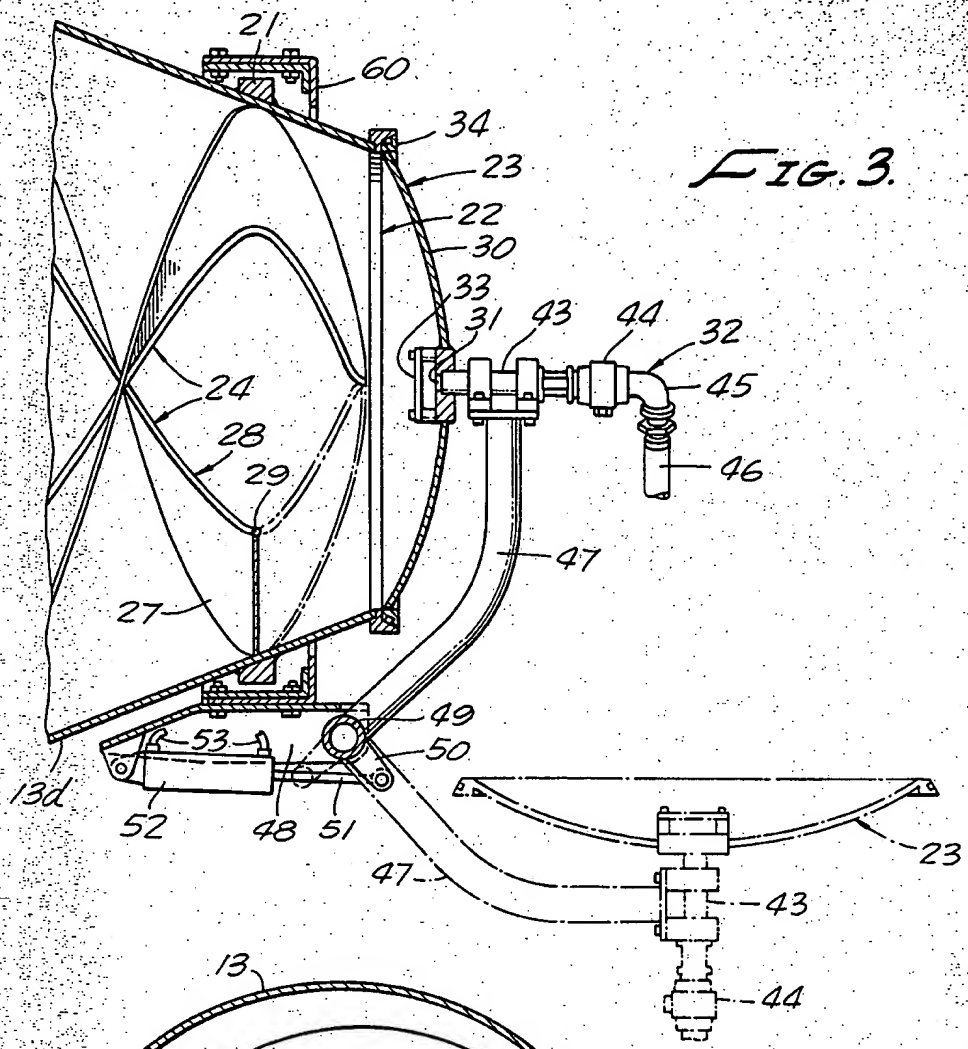
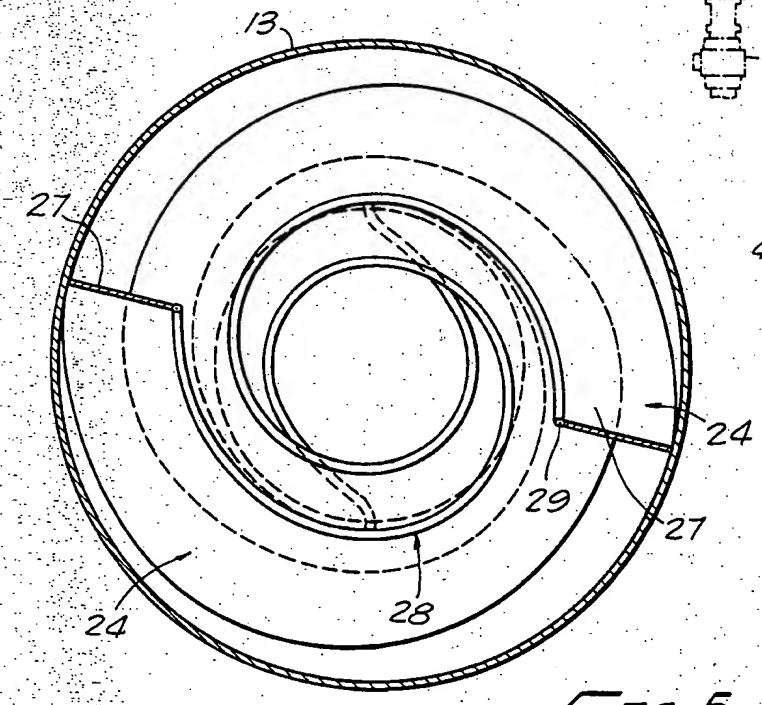


FIG. 3.



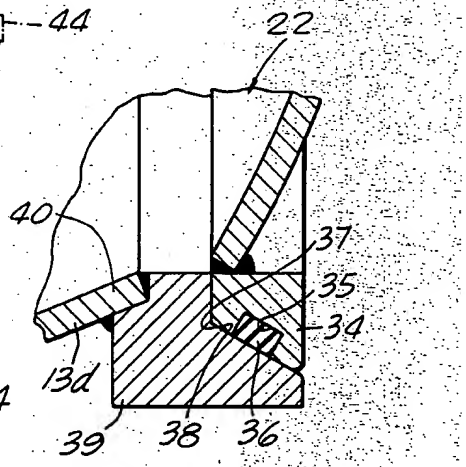


FIG. 4.

FIG. 5.

FOOD PROCESSOR

This application is a continuation of application Ser. No. 196,876, filed 10/14/80, abandoned.

BACKGROUND OF THE INVENTION

This invention relates to processing food and products for food. In particular, the invention is directed to the kneading of a multiplicity of substantially integral food pieces, for instance, chunks of meat, fruits or cheese wheels or the like.

The prior art of such food processing is described with reference to the massaging and tumbling of chunks of meat, and in this regard the meat products are, for example, cured hams, ham products, bacon bellies, corn beef briskets, or fresh meats, such as, meat beef rounds, roasts, turkey breasts, or other poultry products. Such meats have been subjected to a tumbling or massaging in various kinds of known apparatus.

Cured meat products are normally needle injected with a curing brine prior to mechanical tumbling or massaging at atmospheric pressure, or alternatively under a vacuum. The purpose of tumbling and massaging is to accelerate the curing process, improve distribution of the curing ingredient and to extract the "bind" protein myosin.

The extraction of myosin results in a sticky or tacky meat surface which improves moisture absorbtion and retention and enhances product coherency during processing.

Massaging boneless hams can improve and accelerate the distribution of injected curing brine resulting in a better cure in less time and most importantly, the yield of the ham after cooking is increased by 5% to 7%. Tumbling of beef rounds or turkey breasts results in a condition that permits several pieces to be stuffed in casings or placed in molds for precooking. After chilling, the agglomerated meat can be thinly sliced without falling apart. Tumbling or massaging also results in other benefits such as improving uniformity of color, tenderness, pliability, control of shrinkage, and reduced cooking losses.

Generally, pale, soft meat such as pork and chicken is massaged while dark, firm meat such as beef, mutton and turkey is tumbled. Tumbling involves the result of "impact energy" influences on muscle such as would occur in allowing meat to fall from the upper part of a rotating drum, or striking it with paddles or baffles. Massaging is a less physically vigorous process and involves "frictional energy" resulting from the rubbing of one meat surface on another, or on a smooth surface of a container.

Known apparatus for this massage processing includes vertical paddle massagers which are shown in U.S. Pat. No. 4,038,426 (Jespersen) and U.S. Pat. No. 3,934,860 (Michels). In such vertical paddle massaging, the paddles are suspended from above to engage the product, and the units may be portable and transportable from the brine injector lines to a process area. Unloading of the tanks is accomplished by tipping the entire unit with hydraulically actuated dumpers. Such paddle massagers are not suitable for bone-in ham due to product damage and are used almost exclusively for boneless ham production. Even for such boneless products, the rotating paddles or stirring blades drag products through the mass of the load. This results in the tearing away and separation of pieces from the main chunks.

Vacuum massagers are basically of two kinds. One incorporates a drum or barrel shaped vessel which rotates in a horizontal position on powered rollers. Such a unit is internally equipped with longitudinal or angularly rotated shelves to effect lifting and mixing. The drum is loaded from the top while in a vertical position and then tilted down 90° for tumbling on rollers. Such massagers require considerable labor for loading and unloading. An example of such an arrangement is shown in U.S. Pat. No. 3,880,067 (Hoffman).

The second kind of vacuum massager is of the sort illustrated in U.S. Pat. Nos. 4,029,824 (Langen), 4,036,122 (Langen), and 3,746,316 (Langen). This system involves an elaborate "Y" configuration vessel with one leg of the "Y" detachable. The drum rotates about a central axis to allow the meat to tumble under the vacuum from one chamber to the next. This system usually involves several detachable chambers or round stainless steel meat tubs mounted on wheels which are used as product collection and transportation containers. Food containers are attached to a conveyor system for indexing to the "Y" drum area. Brine injector heads equipped with a pattern of injection needles may be provided in the two permanent chambers. Because of the height from which the chunks of meat fall from chamber to chamber, damage in the sense of bruising the meat occurs. Where injector needles are employed, tearing or shredding of the muscle is additionally caused.

In the prior art of tumblers, it is known to provide atmospheric pressure tumblers which are horizontal drums, conical at each end and equipped with a manually operated door. Internal horizontal shelves effect the necessary lifting of the product. Such tumblers are used primarily for extracting the bind protein myosin in the preparation of precooked sectioned and formed beef products.

Vacuum tumblers incorporate a horizontal drum running on powered rollers and function much like a laundry tumbler in that it tilts to discharge. The product is loaded through a fold-away chute located at the drum center. The chute is pivoted out of the way and a vacuum door is placed over the charging opening during processing.

There are various other devices designed for other purposes that may have been used or tried by the meat processing industry from time to time, such as ribbon blenders employing helical paddles mounted on and rotated by a central shaft in a cylinder that are used in the chemical industry and small tilting drum-type concrete mixers, but insofar as can be determined, none of such devices has been considered satisfactory or successful, since they have not been adopted.

In the field of kneading food pieces and in view of the above limitations and disadvantages of the prior art, there is a need to provide a means for and method of food processing which can provide a gentle low speed rolling or massaging action on the food pieces.

In particular, with the processing of meat it is necessary to minimize bruising of the product and situations where static load conditions can cause tearoffs or separation. Also in regard to the vacuum tumbling or massaging of meat there is also the need to produce high quality meat products which are uniform in cure, bright in color, free of bruises with the entire meat structure intact and dense in mess.

Furthermore, there is a need for a single high productivity meat massager which permits for prompt processing of slaughtered animals, thereby to minimize the time during which muscles contract and rigor mortis sets in. There is thus a need for a masssager which requires less down time during which the curing brine would only penetrate through osmosis.

There is also a need for a processer which can operate both as a massager and a tumbler, and the prior art discloses units which are either only tumblers or massagers. In such a composite unit there is therefore the requirement for slow speed massaging and a higher speed dynamic tumbling where a requisite amount of physical abrasion is desirable.

Additional needs include those of a reduced capital cost, power, and handling requirements, working space and maintenance. It is also desirable to have a processor which is substantially more self-cleaning than existing processors.

SUMMARY OF INVENTION

Apparatus and method for kneading a multiplicity of substantially integral food pieces including a rotatable drum having spiralling flight means mounted about the inside wall between a closed end and an open end of the drum in which, upon rotation of the drum, the food pieces are kneaded by contact with each other, with the type and magnitude of the kneading action being variable by changes in drum speed and direction of rotation. A further improvement includes door means provided on the open end of the drum, and, in some preferred forms of the invention, a means for drawing a vacuum in the drum during processing.

The invention also has application to various requirements in the processing of food products such as the blending of different constituents for a final food product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the apparatus showing the drum partly in section,

FIG. 2 is an end view along line 2—2 of FIG. 1 showing the drum from the open end with the door means closed on the end,

FIG. 3 is a partial sectional side view showing details of the door means and also illustrating, in phantom lines, the door means in an open position,

FIG. 4 is a detailed sectional side view showing the engagement reinforcing flange of the door means with the engagement reinforcing flange about the open end of the drum,

FIG. 5 is a sectional end view through the drum along line 5—5 of FIG. 1 in the direction towards the open end of the drum,

FIG. 6 is a sectional end view through the drum along line 6—6 of FIG. 1 in a direction toward the closed end of the drum,

FIG. 7 is a detailed sectional end view through a vane of the flight means in the drum, and showing the connection of the vane to the side wall of the drum,

FIG. 8 is a detailed sectional side view showing the hatch means in the side wall of the drum.

DETAILED DESCRIPTION

The apparatus of this invention for kneading a multiplicity of substantially integral food pieces, such as chunks of meat, includes a rotatable drum **10** of stainless steel and having a glass bead blasted finish mounted on an axis inclined to the horizontal and suported by pedestals **11** and **12**. The drum includes a side wall **13** made up of four segments **13***a*, **13***b*, **13***c* and **13***d* so that segment **13***a* tapers away from a closed end **14** to a larger diameter about the central section **13***b* and thereafter tapers at segments **13***c* and **13***d* gradually towards a smaller diameter at an open end of the drum **10**. The closed end **14** of the drum **10** includes a centrally located internal conical housing **15**. This housing **15** is formed by a portion **16** of end wall **14**, a conical internal wall **17**, and central circular segment **18** inside the drum **10**. The conical housing **15** defines an area through which a relatively conventional direct hydrostatic drive means **19** can be drivingly coupled to the closed end **14** of drum **10**. The hydrostatic drive **19** is itself mounted on the pedestal **11** and thereby effects the drum mounting support axially at the closed end **14** of the drum **10**.

Pedestal **12** is located about the side wall **13** remotely from the closed end **14** and thereby provides an additional mounting to the drum **10**. On top of pedestal **12** there are rollers **20** on which a track **21** on the side wall **13***d* of the drum is adapted to run. In this manner, the drum is rotatable about its longitudinal axis which is inclined to the horizontal in a range between about 10° to 15°, preferably 12°.

The drum **10** provides an open end **22** which is closed by door means **23** as may be required in operation of the drum **10**. The flight means mounted on the inside of the side wall **13** and extend substantially over the length of the drum **10** between the closed end **14** and the open end **22**. The flight means are defined by two spiralling vanes **24** which are 180° out of phase with each other and are mounted about the inside of the side wall **13** of the drum **10**. The lead angle of the vane **24** is designed relative to the side wall segments **13***a*, **13***b*, **13***c*, and **13***d* such that upon rotation in a first direction the food pieces or food product **25** within the drum **10** are urged towards the closed end **14** of drum **10**. Rotation in the opposite direction causes the contents **25** to be urged toward open end **22** and, when the door means **23** is opened, to be discharged through the open end **22** of drum **10**. The lead angle in the central areas **13***b* and **13***c* of the drum **10** is about 26° and is somewhat less at the discharge section **13***d* of the side wall **13** due to the decreasing diameters of the side wall **13**.

Vanes **24** meet the conical wall **17** at the closed end **14** substantially at right angles, and this is achieved by providing lips **26** substantially right angularly directed relative to the normal planar section **27** of the vanes **24**. Such right angular engagement of the vanes **24** and wall **17** ensures that food pieces **25** do not wedge in a narrowing tight angle which would otherwise be formed if the vane sections **27** gradually tapered into engagement with the conical wall **17**.

The edge **28** of vanes **24** provides a thickened cross-section **29** so as to minimize deleterious action on the food pieces during operation of drum **10**. Such action could be the bruising of chunks of meat, or unwanted severage of pieces of meat from the pieces **25**. The thickened cross-section **29** is formed by welding a tubular pipe section **29** on top of the plate forming the vanes **24**.

The door means **23** is defined by a dish-shaped plate **30**. Centrally through the plate **30** there is provided a port **31** which is connected with a pipe **32**. Between the port **31** and the interior of drum **10** there is provided a strainer **33** which prevents the passage of particles of food pieces into the port **31** and pipe **32**. About the dish

30, there is a circular reinforcing flange 34 which is provided with a circular slot 35 in which is located a sealing ring 36. The flange 34 provides a tapered edge 37 relative to the plane of the dish 30 which is arranged to abut with a tapered edge 38 formed in a circular reinforcing flange which is welded to the segment 13*d* at its end 40, namely the open end 22 of the drum 10. The mating tapered edges 37 and 38 facilitate self-aligning of the door means 23 with the open end 22 such that an air-tight seal can be created together with sealing ring 36 engaging with the tapered edge 38 as shown.

In the side wall 13 of the drum 10, there are two hatch means 54 and 55. The hatch means are offset from each other in a lateral and longitudinal direction. Each hatch means 54 and 55 includes an opening 56 in the a side wall 13, and a cover 57 which is arranged to move into and from engagement in an axial direction with the opening 56 such that effective sealing of the openings 56 can be made. A sealing ring 58 abuts with the mouth 59 around opening 56. Handle 60, and transverse bar 62 effectively provide for operation of the covers 57.

About the open end 22 to drum 10 there is a mounted shield 61 which covers the mounting rollers 20 and track 21 and effectively screens the opening 22 from those portions of the drum and drive mechanisms 19 and 14 rearwards of the shield 61 in the direction towards the closed end 14 of the drum 10. Affixed to the shield 61 is a delivery hopper 62 so that food pieces 25 discharged from the drum 10 can be fed suitably to a removal means.

A vacuum can be drawn in the inside of drum 10 through pipe 32 by means of a vacuum pump 41 which is mounted on the framework 42 below the drum 10. Generally, pipe 32 is defined by a lead section 43 which is connected with the port 31 and rotating union 44, and elbow 45 connected with flexible vacuum tubing 46 or the like. A valve can be provided in the pipe 32 at any suitable place so that the vacuum pump 41 and drum 10 can be isolated from or connected with each other as desirable. In some cases the union 44 may be removed and, after a suitable vacuum is drawn through the pipe 32, the valve is closed. The vacuum pump 41 is thus isolated from the door means 23 and drum 10.

The door means 23 is connected with an arm 47 projecting from and about the lead section 43 of pipe 32 to a mounting 48 laterally spaced from the side wall 12 of the drum 10. The mounting 48 of projecting arm 47 forms a hinge 49 about which the door means 23 is movable. By having the hinge 49 remote from the dish-shaped plate 30, there is sufficient flexibility permitted to the door means 23 such that the self-alignment of the door means 23 with the open end 22 is facilitated. From the mounting 48 there is a stub 50 which is connected with a piston rod 51 which passes into cylinder 52. Such a piston and cylinder means can be pneumatically driven through the supply pipes 53 to open and close the door means 23 as required. In operation of the processing apparatus the door means 23 is open and chunks of meat 25 are fed into drum 10. If desired, a curing fluid or the like 63 is also introduced into the drum to a requisite level. Alternatively the curing fluid 63 can be injected into the meat chunks 25 prior to loading into the drum 10.

Door 23 is then closed and the drum is rotated in a first direction causing a general force in a direction towards the closed end 14. This acts to massage the meat chunks 25 until the desired properties and characteristics of the meat chunks 25 are obtained. As required, the drum can also be rotated in a reverse direction and, in this event, with the door closed a different and opposite force is applied to the meat chunks 25, thereby imparting different properties to the meat chunks. In some processes, the drum can be retained stationary for desired time periods so as to impart other requisite characteristics to the food pieces 25 in the drum 10.

Discharge of the meat chunks 25 is effected by opening the door 23 and rotating the drum 10 in the appropriate direction such that the meat chunks 25 are drawn upwardly towards the open end 22 from where they fall into the delivery hopper 62 and are removed.

In another application of the invention when the door 23 is closed a suitable vacuum is applied to the drum, which could be up to about one atmosphere, by activating the vacuum pump 41. A pressure gauge 64 measures the vacuum within the drum 10. With the rotary union 44, the vacuum pump 41 is retained connected to the drum 10. In other cases, the vacuum tubing 46 can be disconnected from the door means 23. The vacuum acts to enhance the properties imparted to the meat chunks 25 and also increases the speed with such improved properties can be imparted to the meat. For different processes, different degrees of vacuum and pressure can be imparted to the drum 10.

In a particular example of the processor of the invention for massaging bone-in and boneless meat products, pieces weighing between 49 lbs. to 57 lbs. per cubic foot would be introduced into the drum 10. The pieces 25 are injected with up to 40% curing brine 63. Aside from the seepage of injected brine and a minor amount of free brine, there would be little float present in the load. During massaging all of the free moisture would be absorbed by the meat 25. Upon completion of the process, the load would be more viscous, yet, remain slippery and easy to handle.

The apparatus can be used for the kneading and processing of other food pieces. In this regard, examples are massaging of citrus products whereby the fruit is softened prior to squeezing or pulping. Likewise, the massaging of cheese wheels to effect homogenous conditions within the cheese is another process. There are also applications for the blending of food products and various components for food products in the apparatus.

Inspection of the contents of the drum 10 is made possible through the hatch means 54 and 55. By having the hatches 54 and 55 displaced on the drum 10 as indicated, inspection of different areas within the drum is possible. The hatch means also facilitate flushing of the drum during cleansing, by keeping in the cleansing operation, a cleansing fluid is added to the drum, the hatch means 54 and 55 are closed as is the door 23, and the drum is rotated in either or both directions so as to effect a suitable cleansing action. Thereafter, flushing and draining is effected through the hatch means 54 and 55, or through the open end 22 when the drum 10 is rotated in reverse.

By having the ring 36 mounted in the flange 34 of the door means 23 it is possible to remove the ring 36 simply so as to facilitate the cleansing of the slot 35, and thus enhances the sanitation associated with the apparatus.

A suitable delivery hopper is provided on casters for feeding food pieces 25 such as meat chunks into the drum 10 and in this connection it is desirable that the delivery hopper have a chute which enters the open end 22 of the drum 10. This avoids spillage of liquid which

has a high protein content and this can also avoid a loss in the final yield of the product.

The vacuum pump **41** can be mounted separately from the framework **42** in other embodiments of the invention. Automatic programmed operation of the vacuum pump **41** and hydrostatic drive **19** can be arranged so that preferred operation cycles of processing can be followed.

Advantages of the apparatus include the feature that the structure permits for the increased productivity with less equipment than prior art apparatus necessary for such productivity. For instance, one unit of the invention with a 15,000 lb. capacity is equivalent to nine vertical paddle massagers of 1,700 lb. each. Whereas the unit of this invention operating under vacuum requires only a 6 to 7-hour cycle time, the vertical paddle would require three times as much time for the same massaged end product. Similarly, a vacuum tumbler system of the Langen kind referred to in the prior art above would require two systems to equal the same production output.

Under atmospheric pressure, massaging occurs over a period of about 18 to 24 hours. The speed of rotation during massaging is normally about 2 to 4 rpm. Preliminary tests with the invention have indicated that a fast massaging of meat chunks is possible at a speed of about 10 rpm without causing deleterious effects to the product.

The invented apparatus, operating on a gentle low speed rolling action or at the higher speed massaging, effectively provides a superior product with minimized damage, whether operating under vacuum or at atmosphere.

Furthermore, the massager can also tumble meat or other food pieces at atmosphere or under vacuum, at a speed up to 12 rpm and this versatility and multiple application of the invention is an additional important advantage and contribution of the invention in the art of food processors.

Initial capital costs are substantially reduced with the present invention as is the operating labor and expenses. The costs and labor for cleansing the apparatus are reduced and this can be effected at a rotational speed of about 10–12 rpm.

In different embodiments of the invention it is possible to have the lead angle of the vane **24** in the central areas **13***b* and **13***c* of the drum **10** in a range between 20° and 45°. It appears that the most desirable is in the vicinity of 25° to 30°. One factor which will determine the desirable lead angle is the angle of inclination of the drum to the horizontal, which is also variable according to specific product requirements.

In yet a different form of the invention it is possible to have the hatch means **54** and **55** only longitudinally or only laterally offset from each other. The hatch means **54** and **55** can be in a single section **13***a*, **13***b*, **13***c*, or **13***d* of the side wall **13**, and the hatch means can be midway between the vanes **24** of the flight means.

In place of the piston **51** and cylinder **52** being pneumatically operated, the door means **23** can be hydraulically operated or any other suitable actuator can be used.

In yet a further embodiment of the invention a different sealing arrangement between the door **23** and open end **22** is provided. The door **23** is arranged with a face, rather than a flange **34**, which engages the perimeter of the open end **22**, and between the face and perimeter there is a sealing **36**.

As a preferred embodiment of the present invention has been described and illustrated in detail, those skilled in the art will readily appreciate that various modifications can be made without departing from the spirit of the present invention. Accordingly, the scope of the invention is to be limited only by the appended claims.

I claim:

1. Apparatus for kneading a multiplicity of substantially integral food pieces, comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum and discharging the food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal;

(c) means adapted for drivingly engaging the drum thereby to permit drum rotation; and

(d) spiralling flight means mounted on the inside of the sidewall of the drum and extending over substantially the length between the closed end and the open end of the drum, said spiralling flight means projecting inwardly from the sidewall for causing the integral food pieces to be continuously forced to move longitudinally within the drum from end to end in both directions and relative to the other integral food pieces by the movement of the spiralling flight means through the multiplicity of food pieces during rotation in the direction wherein the spiralling flight means progresses from the open end toward the closed end and whereby the integral food pieces are kneaded by contact with each other during said longitudinal movement within the drum, and on rotation in the opposite direction the spiralling flight means acts on the integral food pieces to move said integral food pieces generally to the drum open end;

the inside of the drum and the flight means providing a structural surface without sharpened features or edges whereby the food pieces are not subject to substantial separation during movement within the drum.

2. Apparatus as claimed in claim **1** including door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end.

3. Apparatus as claimed in claim **2** wherein the door means includes a dish-shaped plate to extend outwardly from the drum and is adapted to form an airtight seal with the open end of the drum when in the closed position.

4. Apparatus as claimed in either claim **2** or claim **3** including a port to the interior of the drum for permitting a vacuum to be drawn in the drum, said port being connected with a pipe, and said pipe being adapted for connection to a vacuum pump.

5. Apparatus as claimed in either claim **2** or claim **3** including a port in the door means for permitting a vacuum to be drawn in the drum, said port being connected with a pipe, and said pipe being adapted for connection to a vacuum pump.

6. Apparatus as claimed in claim **5** including a valve in the pipe thereby to permit the pipe opening and closure.

7. Apparatus as claimed in claim **4** including a rotary union in the pipe thereby permitting the vacuum pump

to be continuously connected with the port during drum rotation.

8. Apparatus as claimed in claim 5 including a rotary union in the pipe thereby permitting the vacuum pump to be continuously connected with the port in the door means during drum rotation.

9. Apparatus as claimed in claim 5 wherein the vacuum is in a pressure range of up to substantially one atmosphere pressure.

10. Apparatus as claimed in either claim 2 or claim 3 including means for accommodating sealing means between the door means and the open end of the drum.

11. Apparatus as claimed in claim 10 including sealing means between open end and door.

12. Apparatus as claimed in either claim 2 or claim 3 including a slot around the edge of the door means, said slot being adapted to accommodate a sealing ring for mating location against an adjacent mating edge around the open end of the drum.

13. Apparatus as claimed in claim 2 wherein the edge of the door means accommodating the slot is tapered relative to the plane of the door means, and wherein the abutting edge of the open end includes a mating taper, said mating tapered edges facilitating alignment of the door means with the open end.

14. Apparatus as claimed in claim 13 including the sealing ring.

15. Apparatus as claimed in claim 5 including a strainer element mounted on the door means, said strainer being located inwardly of the port in the door means thereby to prevent the passage of food pieces from the drum into the pipe.

16. Apparatus as claimed in either claim 2 or claim 3 wherein the door means includes an arm projecting from the door means, said arm connecting the door means to a mounting laterally spaced from the side wall of the drum, and said mounting providing a hinge for the door means.

17. Apparatus as claimed in claim 16 including a powered actuator for activating the projecting arm of the door means thereby to permit door movement between the position of closure and opening.

18. Apparatus as claimed in claim 17 wherein the powered actuator is a pneumatically driven piston and cylinder.

19. Apparatus as claimed in either claim 1 or claim 2 including hatch means in the side wall of the drum.

20. Apparatus as claimed in claim 19 including at least two hatch means in the side wall of the drum, said hatch means being offset relative to the drum.

21. Apparatus as claimed in either claim 1 or claim 2 wherein the flight means includes at least two vanes offset from each other.

22. Apparatus as claimed in claim 21 wherein the flight means includes a pair of vanes substantially 180° offset from each other.

23. Apparatus as claimed in claim 22 wherein the edge of the vanes remote from the side wall is thickened thereby to minimize deleterious action of the vanes on the food pieces.

24. Apparatus as claimed in either claim 1 or claim 2 wherein the flight means includes a thickened cross-section thereby to minimize deleterious action of the vanes on the food pieces.

25. Apparatus as claimed in either claim 1 or claim 2, wherein said flight means provides a lip section in a direction substantially right-angularly directed relative to the normal direction of the flight means, and wherein said lip section meets the closed end of the drum at substantially right angles.

26. Apparatus as claimed in claim 1 including a shield substantially about the open end of the drum, the shield screening the open end from the mounting means and means adapted for drivingly engaging the drum.

27. Apparatus as claimed in claim 1 including a discharge hopper extending from below the open end of the drum for removal of food pieces discharged from the open end of the drum.

28. Apparatus for massaging a multiplicity of meat chunks comprising:

a. a rotatable drum having a side wall, a closed end to the drum, and an open end for feeding the meat chunks into the drum and discharging the meat chunks from the drum, the open end being opposite the closed end;

b. a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends, such axis being inclined to the horizontal, said mounting means being connected with the drum axially at the closed end and about the side wall remotely located from the closed end;

c. at least two spiralling vanes mounted on the inside of the wall of the drum and offset from each other;

d. means adapted for drivingly engaging the drum thereby to permit drum rotation;

e. door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end, said door means being adapted to form an airtight seal with the open end of the drum when in the closed position; and

f. port means for permitting a vacuum to be drawn in the drum.

29. Apparatus as claimed in claim 24 including hatch means in the side wall of the drum.

30. Apparatus as claimed in claim 29 including at least a pair of hatch means in the side wall of the drum, said hatch means being located between the vanes.

31. Apparatus as claimed in either claim 28, 29 or 30 wherein the inclined axis is in the range between 10° and 15° to the horizontal.

32. Apparatus for processing a food product comprising:

a. a rotatable drum having a side wall, a closed end to the drum, and an open end for feeding the food product into the drum and discharging the food product from the drum, the open end being opposite the closed end;

b. mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends, such axis being inclined to the horizontal, said mounting means being connected with the drum axially at the closed end and about the side wall remotely located from the closed end;

c. at least a pair of spiralling vanes mounted on the inside of the wall of the drum, the vanes being offset substantially 180° from each other and extending substantially between the closed end and the open end of the drum;

d. means adapted for drivingly engaging the drum thereby to permit drum rotation;

e. door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end, said door means being adapted to form an airtight

seal with the open end of the drum when in the closed operative position;

f. port means for permitting a vacuum to be drawn in the drum.

33. Apparatus as claimed in claim 32 including hatch means in the side wall of the drum.

34. Apparatus as claimed in claim 33 including at least two hatch means, the hatch means being substantially longitudinally offset relative to the drum.

35. Apparatus as claimed in either claim 32, 33 or 34 wherein the inclined axis is in the range between 10° and 15° to the horizontal.

36. Apparatus for kneading a multiplicity of substantially integral food pieces comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum, and discharging food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal, the mounting means being connected with the drum at least about the sidewall remotely located from the closed end;

(c) means adapted for drivingly engaging the drum to permit drum rotation;

(d) spiralling flight means mounted on the inside of the side wall of the drum and extending over substantially the length between the closed end to the open end of the drum, said spiralling flight means projecting inwardly from the sidewall and having a configuration to cause continuous movement of substantially all the food pieces within the drum during drum rotation;

(e) door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end, said door means being adapted to form a substantially air-tight seal with the open end of the drum when in the closed position; and

(f) port means for permitting a change of pressure to be affected in the drum.

37. Apparatus for kneading a multiplicity of substantially integral food pieces comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum, and discharging food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal, the mounting means being connected with the drum at least about the sidewall remotely located from the closed end;

(c) means adapted for drivingly engaging the drum to perm drum rotation; and

(d) spiralling flight means mounted on the inside of the side wall of the drum and extending over substantially the length between the closed end to the open end of the drum, said spiralling flight means projecting inwardly from the sidewall and leaving a configuration to cause continuous movement of substantially all the food pieces within the drum during drum rotation, said flight means being imperforate and including a thickened cross section thereby to minimize deleterious eaction of the flight means on the food pieces; and

(e) the inside of the drum and flight means providing a structural surface without sharpened features or edges whereby the food pieces are not subjected to a separating action during movement within the drum.

38. Apparatus for kneading a multiplicity of substantially integral food pieces comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum, and discharging food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal, the mounting means being connected with the drum at least about the sidewall remotely located from the closed end;

(c) means adapted for drivingly engaging the drum to permit drum rotation;

(d) spiralling flight means mounted on the inside of the side wall of the drum and extending over substantially the length between the closed end to the open end of the drum, said spiralling flight means projecting inwardly from the sidewall and having a configuration to cause continuous movement of substantially all the food pieces within the drum during drum rotation and wherein said flight means meets the closed end of the drum at an angle for inhibiting a wedging, between the closed end and the flight means, of integral food pieces.

39. Apparatus for kneading a multiplicity of substantially integral food pieces, comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum and discharging the food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal;

(c) means adapted for drivingly engaging the drum thereby to permit drum rotation; and

(d) spiralling flight means mounted on the inside of the sidewall of the drum and extending over substantially the length between the closed end and the open end of the drum, said spiralling flight means projecting inwardly from the sidewall for causing the integral food pieces to be continuously forced to move longitudinally within the drum from end to end in both directions and relative to the other integral food pieces by the movement of the spiralling flight means through the multiplicity of food pieces during rotation in the direction wherein the spiralling flight means progresses from the open end toward the closed end and whereby the integral food pieces are kneaded by contact with each other during said longitudinal movement within the drum, and on rotation in the opposite direction the spiralling flight means acts on the integral food pieces to move said integral food pieces generally to the drum open end;

the inside of the drum and the flight means providing a structure having continuous surfaces and rounded edges for causing said longitudinal movement and kneading of the food pieces without sub-

stantial cutting, abrading, puncturing or separation of said food pieces.

40. Apparatus for kneading a multiplicity of substantially integral food pieces, comprising:

(a) a rotatable drum having a sidewall, a closed end to the drum, and an open end for feeding the food pieces into the drum and discharging the food pieces from the drum, the open end being opposite the closed end;

(b) a mounting means for the drum to permit drum rotation about a longitudinal axis extending between the ends at an incline to the horizontal;

(c) means adapted for drivingly engaging the drum thereby to permit drum rotation;

(d) spiralling flight means mounted on the inside of the sidewall of the drum and extending over substantially the length between the closed end and the open end of the drum, said spiralling flight means projecting inwardly from the sidewall for causing the integral food pieces to be continuously forced to move longitudinally within the drum from end to end in both directions and relative to the other integral food pieces by the movement of the spiralling flight means through the multiplicity of food pieces during rotation in the direction wherein the spiralling flight means progresses from the open end toward the closed end and whereby the integral food pieces are kneaded by contact with each other during said longitudinal movement within the drum, and on rotation in the opposite direction the spiralling flight means acts on the integral food pieces to move said integral food pieces generally to the drum open end;

the inside of the drum and the flight means providing a structural surface without shapened features or edges whereby the food pieces are not subjected to substantial separation during movement within the drum;

(e) door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end of a door means being adapted to form a substantial air-tight seal with the open end of the drum when in the closed position;

(f) port means for permitting a change of pressure to be effected in the drum;

(g) the flight means being imperforate and including a thickened cross-section thereby to minimize deleterious action of the flight means on the food pieces; and

(h) the flight means including lip means disposed at an angle to the flight means, said lip means meeting the closed end of the drum at an angle for inhibiting a wedging, between the closed end and the lip means, of integral food pieces.

41. Apparatus as claimed in any one of claims 37, 38, 39 including door means mounted for movement between a position of closure with the open end of the drum and an outward position remote from the open end.

42. Apparatus as claimed in claim 41 wherein the door means includes a dish-shaped plate to extend outwardly from the drum and is adapted to form an airtight seal with the open end of the drum when in the closed position.

43. Apparatus as claimed in either claim 41 or 42 including a port to the interior of the drum for permitting a vacuum to be drawn in the drum, said port being connected with a pipe, and said pipe being adapted for connection to a vacuum pump.

44. Apparatus as claimed in either claim 41 or 42 including a port in the door means for permitting a vacuum to be drawn in the drum, said port being connected with a pipe, and said pipe being adapted for connection to a vacuum pump.

45. Apparatus as claimed in claim 44 including a valve in the pipe thereby to permit the pipe opening and closure.

46. Apparatus as claimed in claim 43 including a rotary union in the pipe thereby permitting the vacuum pump to be continuously connected with the port during drum rotation.

47. Apparatus as claimed in claim 44 including a rotary union in the pipe thereby permitting the vacuum pump to be continuously connected with the port in the door means during drum rotation.

48. Apparatus as claimed in claim 44 wherein the vacuum is in a pressure range of up to substantially one atmosphere pressure.

49. Apparatus as claimed in either claim 41 or claim 42 wherein the door means includes an arm projecting from the door means, said arm connecting the door means to a mounting laterally spaced from the side wall of the drum, and said mounting providing a hinge for the door means.

50. Apparatus as claimed in claim 49 including a powered actuator for activating the projecting arm of the door means thereby to permit door movement between the position of closure and opening.

51. Apparatus as claimed in claim 50 wherein the powered actuator is a pneumatically driven piston and cylinder.

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